Docket No.: C1037.70048US00
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Arthur M. Krieg et al.
Serial No.:	10/644,052
Confirmation No.:	4791
Filed:	August 19, 2003
For:	IMMUNOSTIMULATORY NUCLEIC ACIDS
Examiner:	N. Archie
Art Unit:	1645

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Dated: 2/3/2011 Signature for [signature]

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION OF ARTHUR KRIEG

Dear Sir:

1. I am the Chief Scientific Officer of Pfizer's Oligonucleotide Therapeutics Unit located in Cambridge, MA and Düsseldorf, Germany. Prior to my current position, I was the Chief Scientific Officer and co-founder of the Coley Pharmaceutical Group. Before I co-founded the Coley Pharmaceutical Group, I was a Professor of Internal Medicine at the University of Iowa. I have extensive experience in the research and development of oligonucleotide-based therapeutics. A copy of my CV is attached.

2. I am listed as an inventor on the above-identified patent application, and have assigned my rights in the invention to Coley Pharmaceutical Group, Inc., currently a wholly owned subsidiary of Pfizer Inc.

3. I have reviewed the above-identified patent application, the pending claims, the Office Action dated August 5, 2010, and the two cited prior art references, one of which is one of my earlier applications, Krieg et al. (WO01/22972) and the other is Yamamoto et al. (1994, Microbiol. Immunol. 38: 831-836).

4. As indicated in the Office Action, claims 108-114 have been rejected as allegedly obvious in view of Krieg et al. and Yamamoto et al. In general, these claims relate to oligonucleotides with stabilized internucleotide linkages and having at least one internal phosphodiester CG linkage (*i.e.*, non-stabilized). In my opinion, claims 108-114 would not have been obvious to one skilled in the art for the reasons stated below.

5. At the time of filing of the priority application for the above-identified patent application, it was known in the art that oligonucleotides having at least one unmethylated CG dinucleotide were immunostimulatory (so-called CpG oligonucleotides).

6. As of the time of filing the priority application (August 19, 2002), a skilled researcher would have expected that CpG oligonucleotides having stabilized internucleotide linkages (*e.g.*, phosphorothioate linkages) would have some increased activity, for instance B cell activity, as compared to CpG oligonucleotides without stabilized internucleotide linkages. For example, WO01/22972, on page 36, line 17, discusses oligonucleotides with stabilized (modified) linkages and states that "It is believed that these modified nucleic acids may show more stimulatory activity due to enhanced nuclease resistance, increased cellular uptake, increased protein binding, and/or altered intracellular localization". Therefore, one would have expected that an oligonucleotide in which all linkages are stabilized would have increased immunostimulatory activity compared to the same oligonucleotide having one or more non-stabilized linkages.

7. One of skill in the art would have expected that replacing the stabilized internucleotide linkage with a non-stabilized linkage in the critical CpG dinucleotide, while adjacent non-CpG dinucleotide linkages remain stabilized, would result in an oligonucleotide with decreased immunostimulatory activity in cells because the linkage between the C and G would be susceptible to cleavage.

8. Accordingly, the invention of claims 108-114 involves the unexpected discovery that replacing a stabilized internucleotide linkage with a non-stabilized linkage within a CG dinucleotide results in an oligonucleotide having at least similar (and, in many instances increased) immunostimulatory activity compared to the same oligonucleotide with a stabilized internucleotide CG linkage. As explained above, this finding was unexpected in view of the expectation that a fully stabilized oligonucleotide would have had increased activity compared to the same oligonucleotide having non-stabilized linkages in one or more CpG motifs.

9. Furthermore, the data in the application show that the unexpectedly high immunostimulatory activity is achieved with a broad spectrum of oligonucleotides having a non-stabilized linkage within a CG dinucleotide. For instance, the data in Table 6 (pages 93-94 of the application) show that oligonucleotides having different sequences (compare, *e.g.*, SEQ ID NO:256 and SEQ ID NO:282), different lengths (compare, *e.g.*, SEQ ID NO:260 and SEQ ID NO:282), or different numbers of CG dinucleotides (compare, *e.g.*, SEQ ID NO:254 and SEQ ID NO:256) all show increased immunostimulatory activity when a stabilized linkage within a CG dinucleotide is replaced with a non-stabilized linkage. Table 6 also provides examples of oligonucleotides having a non-stabilized linkage within a CG dinucleotide that have an immunostimulatory activity that is similar to the fully stabilized version (See, *e.g.*, SEQ ID NO:251 and SEQ ID NO:267).

10. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the above application and any patent or application related thereto.

Arthur M. Krieg, M.D.

24 January 2011

Date

CURRICULUM VITAE

Arthur M. Krieg

2/3/2011

I. EDUCATIONAL AND PROFESSIONAL HISTORY

A. Higher Education

1979	B.S. (Biology) (with honors)	Haverford College, Haverford, Pennsylvania
1983	M.D.	Washington University Medical School, St. Louis, Missouri

Postgraduate Medical Education

1983-86	Internship and Residency in Internal Medicine	University of Minnesota Hospitals, Minneapolis, MN
1986-88	Medical Staff Fellow	National Institute of Arthritis and Musculoskeletal and Skin Diseases, NIH, Bethesda, MD
1988-3/91	Arthritis Foundation Loeb Postdoctoral Fellow and Senior Staff Fellow	National Institute of Arthritis and Musculoskeletal and Skin Diseases, NIH, Bethesda, MD

Certification

Board	Number	Date	Recertification
American Board of Internal Medicine	110422	9/10/86	
American Board of Rheumatology	110422	11/6/90	2001

Licensure

State	Date	Perm./Temp.	Number	Renewal Date
Maryland			D34514	9/30/92
Iowa	3/16/91	Perm.	27996	8/1/99

Memberships

Board	Number	Date	Renewal Date
American Association for Cancer Research (AACR)	38377	01/28/04	

II. TEACHING AT THE UNIVERSITY OF IOWA

B. Professional and Academic Positions

1. Academic

3/91-6/95	Assistant Professor, Rheumatology	Department of Internal Medicine, University of Iowa College of Medicine, Iowa City, Iowa
7/95-6/98	Associate Professor, Rheumatology	Department of Internal Medicine, University of Iowa College of Medicine, Iowa City, Iowa
7/98-present	Professor, Rheumatology	Department of Internal Medicine, University of Iowa College of Medicine, Iowa City, Iowa

2. Professional

1/92-2001	Staff Physician	Veterans Affairs Medical Center Iowa City, IA
1997-2008	Founder and Chief Scientific Officer	Coley Pharmaceutical Group, Wellesley, MA
2008 – Present	Chief Scientific Officer	Research Technology Center, Pfizer, Inc. Cambridge, MA

C. Honors and Awards

Year	Honor
1983	Alpha Omega Alpha
1986	Rheumatology Award, Minneapolis Veterans Hospital
1988	Regina S. Loeb Postdoctoral Fellowship Award
1988	Research Award, Lupus Foundation of Greater Washington
1989	Research Award, Lupus Foundation of Greater Washington
1990	Trainee Award, American Federation for Clinical Research
1990	Henry Christian Award, American Federation for Clinical Research
1990	Senior Scholar Award, American College of Rheumatology
1991	Carver Clinician Scientist
1993	Pfizer Scholar Award
1995	Central Society for Clinical Investigation

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1997	Outstanding Service Award, Lupus Foundation of America
1998	American Society for Clinical Investigation
1998	Henry Kunkel Young Investigator Award, American College of Rheumatology
2000	Who's Who in America
2003	Finalist in the 2003 Ernst & Young New England Entrepreneur Of The Year
2006	ISI Highly Cited Scientist in Immunology
2008	Department of Internal Medicine Distinguished Achievement Award Lecture

A. Teaching Assignments

Classroom, Seminar, Teaching Laboratory

Year	Course Title	(% for which responsible)
1992-95	ICM, Rheumatology	30%
1993-94	Survey of Immunology	10%
1995-2001	Immunology I	10%
1995-7	Introduction to Medical Immunology (M1;20hr/yr)	50%
1997-2001	Course Director; Introduction to Medical Immunology (M1;20hr/yr)	100%

Clinical Teaching (in ward, clinic, or operating room)

(year)	(where teaching occurred)	(wks./year)	(hrs./wk.)
1989-90	NIH wards	4	3
1991-99	Rheumatology Clinic	48	5
1991-	VA Rheumatology Clinic	14	4
1991-97	Rheumatology Consult Service	6	25
1993-96	Introduction to Clinical Medicine	6	3
1993-99	M3 Ambulatory Clinic Teaching	3	20

B. Graduate student supervision and committees

Name: Demetrius Gravis
Degree objective: Ph.D.
Outcome: Ph.D.

Name: Jeffrey Kirsch
Degree objective: Ph.D.
Outcome: MS

Name: Ryan Kniewel
Degree objective: Ph.D.

II. TEACHING AT THE UNIVERSITY OF IOWA

Outcome: MS

Name: Steve Louie
Degree objective: Ph.D.
Outcome: Ph.D.

Name: Cory Best
Degree objective: Ph.D.
Outcome: Ph.D.

Name: Julie Olson
Degree objective: Ph.D.
Outcome: Ph.D.

Name: Yi-Na Hsing
Degree objective: Ph.D.
Outcome: Ph.D.

Name: Stephen Chinnell
Degree objective: Ph.D.
Outcome: Ph.D.

Name: Ian Catlett
Degree objective: Ph.D.
Outcome: Ph.D.

C. Other teaching contributions

Institutional Conferences, Grand Rounds, Journal Clubs, Etc.

1986-90	Autoimmunity Journal Club
1991-	Rheumatology Journal Club
1991-	EMRB Journal Club
9/17/91	Immunology Group Seminar, "Antisense Oligonucleotide Uptake and Use to Inhibit Retroviral Expression"
10/6/91	Invited Speaker: "Environmental and Genetic Factors and Lupus." Lupus Awareness Symposium, Central Pennsylvania Chapter of the Lupus Foundation of America, Hershey, Pennsylvania
10/13/91	Invited Speaker: "Environmental and Genetic Factors and Lupus." Lupus Awareness Symposium, Iowa Chapter of the Lupus Foundation of America, Ames, Iowa
1991-	B Cell Journal Club

II. TEACHING AT THE UNIVERSITY OF IOWA

1/20/92	Invited Speaker: "Environmental and Genetic Factors and Lupus." Lupus Awareness Meeting, Mercy Hospital, Dubuque, IA.
2/6/92	University of Iowa Medical Grand Rounds, "Environmental and Genetic Factors in Lupus"
9/8/92	Medicine Residents Emergency Medicine Lecture, "Rheumatologic Emergencies"
9/11/92	Midwestern Conference on Health Care in the Elderly, XV Annual Meeting, "Rheumatoid Arthritis in the Elderly"
9/15/92	Iowa City Lupus Support Group, "Research Update on Rheumatoid Arthritis and Lupus"
8/13/93	Emergency Medicine Lecture "Rheumatologic Emergencies"
1994	Molecular Medicine Journal Club
8/17/94	Emergency Medicine Lecture: "Rheumatologic Emergencies"
4/10/95	Noon Residents' Lecture: "The Pros and Cons of NSAIDs"
4/22/95	Lupus Foundation of America, Iowa Chapter Spring Meeting, "Research Update on Lupus"
9/5/95	Microbiology Seminar Series, "Immune Activation by Bacterial DNA"
10/13/95	Infectious Disease Seminar, "Bacterial DNA: An Activator of Innate Immunity"
11/15/95	Immunology Seminar Series, "Immune Recognition of Bacterial DNA"
5/2/96	Iowa Flow Cytometry Users Group Meeting, "Use of Flow Cytometry to Study DNA Uptake in Bone Marrow and Peripheral Blood."
8/29/96	University of Iowa Medical Grand Rounds, "It's Not Just a Blue Print Anymore: The Therapeutic Applications of DNA."
12/9/96	Nephrology Conference, "Immune Activation by Bacterial DNA."
6/11/97	Medicine Residents Seminar Series, "Case Studies in Rheumatology"
9/18/97	University of Iowa Medical Grand Rounds, "How the Immune System Sees 'Danger' in Bacterial DNA"
10/17/98	Lupus Fall Seminar, "Lupus: the Disease," Iowa Lutheran Hospital, Des Moines, IA

<u>Teaching Committees:</u>

<u>Medical Student Counseling:</u>

1995	Immunology Medical Student Curriculum Subcommittee

II. TEACHING AT THE UNIVERSITY OF IOWA

D. Course Materials (Syllabi, Instructional Web Pages, Computer Lab Materials)

1995-2001 Introduction to Medical Immunology Syllabus

IV. Other Comments

III. SCHOLARSHIP

A. Publications or Creative Works

Peer-reviewed

1. Dixit, R., Krieg, A.M., and Atkinson, J.P.: Thrombotic Thrombocytopenic Purpura Developing During Pregnancy in a C2 Deficient Patient with a History of Systemic Lupus Erythematosus. *Arthritis Rheum.* 28:341-344, 1985.

2. Krieg, A.M., and Saxena, K.: Cyanide Poisoning from Metal Cleaning Solutions *Ann. Emerg. Med.* 16:582-584, 1987.

3. Krieg, A.M., Steinberg, A.D., and Khan, A.S.: Increased Expression of Novel Full-Length Endogenous MCF-Related Transcript in Autoimmune Mouse Strains. *Virology* 162:274-276, 1988.

4. Krieg, A.M.: Viral Gene Expression and Serology. In: Steinberg, A.D., moderator. Angioimmunoblastic Lymphadenopathy with Dysproteinemia. *Ann. Intern. Med.* 108:575-584, 1988.

5. Krieg, A.M., Khan, A.S., and Steinberg, A.D.: Multiple Endogenous Xenotropic and MCF Murine Leukemia Virus-Related Transcripts are Induced by Polyclonal Immune Activators. *J. Virology* 62:3545-3550, 1988.

6. Steinberg, A.D., Klinman, D.M., Krieg, A.M., Seldin, M.F., and Kastner, D.L.: Approach to the Use of Antigen Non-Specific Immunosuppression in Systemic Lupus Erythematosus and Other Rheumatic Autoimmune Diseases. *J. Autoimmunity* 1:575-592, 1988.

7. Durand, J.P., El-Zaatari, F.A.K., Krieg, A.M., and Taurog, J.D.: Restriction Fragment Length Polymorphism of T Cell Receptor α and ß Chain Genes in Patients with Ankylosing Spondylitis. *J. Rheumatol.* 15:1115-1118, 1988.

8. Krieg, A.M., Khan, A.S., and Steinberg, A.D.: Expression of an Endogenous Retroviral Transcript is Associated with Murine Lupus. *Arthritis Rheum.* 32:322-329, 1989.

9. Flanagan, J.R., Krieg, A.M., Max, E.E., and Khan, A.S.: Negative Control Region Near the 5' End of Murine Leukemia Virus Long Terminal Repeats. *Mol. Cell. Biol.* 9:739-746, 1989.

10. Krieg, A.M., Gause, W.C., Gourley, M., and Steinberg, A.D.: A Role for Endogenous Retroviral Sequences in the Regulation of Lymphocyte Activation. *J. Immunol.* 143:2448-2451, 1989.

11. Gourley, M.F., Krieg, A.M., and Steinberg, A.D.: Preferential Nuclear Compartmentalization of Endogenous MCF-Related Retroviral Transcripts. *J. Exp. Med.* 171:1443-1452, 1990.

IV. Other Comments

12. Krieg, A.M., and Steinberg, A.D.: Analysis of Thymic Endogenous Retroviral Expression in Murine Lupus: Genetic and Immune Studies. *J. Clin. Invest.* 86:809-816, 1990.

13. Krieg, A.M., Gourley, M.F., and Steinberg, A.D.: Association of Murine Lupus and Full-Length Endogenous Retroviral Expression Maps to the Bone Marrow Stem Cell. *J. Immunol.* 146:3002-3005, 1991.

14. Krieg, A.M., Gmelig-Meyling, F., Gourley, M.F., Kisch, W.J., Chrisey, L.A., and Steinberg, A.D.: Uptake of Oligodeoxyribinucleotides by Lymphoid Cells is Heterogeneous and Inducible. *Antisense Research and Development* 1:161-171, 1991.

15. Klinman, D., Krieg, A.M., Conover, J., Ussery, M.A., and Black, P.L.: Effect of Cyclophosphamide, Total Body Irradiation and Zidovudine on Retrovirus Proliferation and Disease Progression in Murine AIDS. *AIDS Res.* 8:101-106, 1991.

16. Krieg, A.M.: Bacteria, Viruses, Drugs. In: Steinberg, A.D., Moderator, Systemic Lupus Erythematosus: Considerations of Pathogenesis. *Ann. Intern. Med.* 115:548-559, 1991.

17. Gourley, M.F., Kisch, W.J., Mojcik, C.F., King, L.B., Krieg, A.M., and Steinberg, A.D.: Molecular Aspects of Systemic Lupus Erythematosus: Murine Endogenous Retroviral Expression. *DNA and Cell Biology* 11:253-257, 1992.

18. Matson, S., and Krieg, A.M.: Nonspecific Suppression of ^{3}H-thymidine Incorporation by "Control" Oligonucleotides. *Antisense Research and Development* 2:325-330, 1992.

19. Krieg, A.M., Gourley, M.F., Klinman, D.M., Perl, A., and Steinberg, A.D.: Heterogeneous Expression and Induction of Human Endogenous Retroviral Sequences in Peripheral Blood Mononuclear Cells from Patients with Polymyositis and Controls. *AIDS Research and Human Retroviruses* 8:1991-1998, 1992.

20. Zhao, Q., Matson, S., Herrara, C.J., Fisher, E., Yu, H., and Krieg, A.M.: Comparison of Cellular Binding and Uptake of Antisense Phosphodiester, Phosphorothioate, and Mixed Phosphorothioate and Methylphosphonate Oligonucleotides. *Antisense Res. Devel.* 3:53-66, 1993.

21. Krieg, A.M,. Tonkinson, J., Matson, S., Zhao, Q., Saxon, M., Zhang, L., Bhanja, U., Yakubov, L., and Stein, C.A.: Modification of Antisense Phosphodiester Oligodeoxynucleotides by a 5' Cholesterol Moiety Increases Cellular Association and Improves Efficacy. *Proc. Natl. Acad. Sci. USA* 90:1048-1052, 1993.

22. Louie, S.W., Ramirez, L.M., Krieg, A.M., Maliszewski, C.R., and Bishop, G.A.: Interleukin 4 is an Autocrine Growth Factor for a Transformed B Cell Clone. *J. Immunol.* 150:399-406, 1993.

IV. Other Comments

23. Mojcik, C.F., Gourley, M.F., Klinman, D.M., Krieg, A.M., Gmelig-Meyling, F., and Steinberg, A.D.: Administration of a Phosphorothioate Oligonucleotide Antisense to Murine Endogenous Retroviral MCF env Causes Immune Effects *In Vivo* in a Sequence-Specific Manner. *Clin. Immunol. Immunopathol.* 67:130-136, 1993.

24. Krieg, A.M. and Stein, C.A.: Problems in Interpretation of Data Derived from *In Vitro* and *In Vivo* Use of Antisense Oligodeoxynucleotides. *Antisense Res. Devel.* 4:67-69, 1994.

25. Zhao, Q., Waldschmidt, T., Fisher, E., Herrera, C.J., and Krieg, A.M.: Stage-Specific Oligonucleotide Uptake in Murine Bone Marrow B Cell Precursors. *Blood* 84:3660-3666, 1994.

26. Teasdale, R.M., Matson, S.J., Fisher, E., and Krieg, A.M.: Inhibition of T4 Polynucleotide Kinase Activity by Phosphorothioate and Chimeric Oligodeoxynucleotides. *Antisense Research and Development* 4:298, 1994.

27. Fathi, R., Huang, Q., Coppola, G., Delaney, W., Teasdale, R., Krieg, A.M., and Cook, A.F.: Oligonucleotides with Novel, Cationic Backbone Substituents: Aminoethylphosphonates. *Nucleic Acids Research* 22:5416-5424, 1995.

28. Krieg, A.M., Yi, A-K., Matson, S., Waldschmidt, T., Bishop, G.A., Teasdale, R., Koretzky, G., and Klinman, D.: CpG Motifs in Bacterial DNA Trigger Direct B Cell Activation. *Nature* 374:546-549, 1995.

29. Bishop, W.P., Lin, J., Wen, J.T., Stein, C.A., and Krieg, A.M.: Interruption of a TGFα-EGF Receptor Autocrine Loop in Caco-2 Cells by TGFα Antisense Oligonucleotides. *Gastroenterology* 109:1882-1889, 1995.

30. Ishigatsubo, Y., Krieg, A.M., and Klinman, D.M.: Increased Utilization of Polyreactive B Cells during Periods of Generalized Immunologic Activation. *Autoimmunity* 22(2): 113-119, 1995.

31. Motokawa, S., Hasunuma, T., Tajima, K., Krieg, A.M., Ito, S-I., Iwasaki, K., and Nishioka, K.: High Prevalence of Arthropathy in HTLV-I Carriers on a Japanese Island. *Ann. Rheum. Dis.* 55:193-195, 1996.

32. Klinman, DM, Yi, A., Beaucage, S.L., Conover, J., and Krieg, A.M.: CpG Motifs Expressed by Bacterial DNA Rapidly Induce Lymphocytes to Secrete IL-6, IL-12, and IFN-γ. *Proc. Nat. Acad. Sci* 93:2879-2883, 1996.

33. Yi, A., Chace, J.H., Cowdery, J.S., and Krieg, A.M.: Interferon γ Promotes Interleukin-6 and Immunoglobulin M Secretion in Response to CpG Motifs in Bacterial DNA and Oligodeoxynucleotides. *J. Immunol.* 156:558-564, 1996.

34. Cowdery, J.S., Chace, J.H., Yi, A-K., and Krieg, A.M.: Bacterial DNA Induces NK Cells to Produce Interferon-γ *In Vivo* and Increases the Toxicity of Lipopolysaccharide. *J. Immunol.* 156:4570-4575, 1996.

IV. Other Comments

35. Ballas, Z.K., Rasmussen, W.L., and Krieg, A.M.: Induction of Natural Killer Activity in Murine and Human Cells by CpG Motifs in Oligodeoxynucleotides and Bacterial DNA. *J. Immunol.* 157:1840-1845, 1996.

36. Zhao, Q., Song, X., Waldschmidt, T., Fisher, E., and Krieg, A.M.: Oligonucleotide Uptake in Human Hematopoietic Cells Is Increased in Leukemia and Related to Cellular Activation. *Blood* 88:1788-1795, 1996.

37. Krieg, A.K. Editorial On the Quality Control of Antisense Oligonucleotides. *Antisense & Nucl. Acid Drug Dev.* 6:149, 1996.

38. Yi, A.-K., Klinman, D.M., Martin, T.L., Matson, S., and Krieg, A.M.: Rapid Immune Activation by CpG Motifs in Bacterial DNA: Systemic Induction of IL-6 Transcription Through an Antioxidant-Sensitive Pathway. *J. Immunol.* 157:5394-5402, 1996.

39. Krieg, A.M., Matson, S., Herrera, C., and Fisher, E.: Oligodeoxynucleotide Modifications Determine the Magnitude of Immune Stimulation by CpG Motifs. *Antisense Res. Dev.* 6:133-139, 1996.

40. Yi, A.-K., Hornbeck, P., Lafrenz, D.E., and Krieg, A.M.: CpG DNA Rescue of Murine B Lymphoma Cells from Anti-IgM Induced Growth Arrest and Programmed Cell Death is Associated with Increased Expression of C-myc and bcl-XL. *J. Immunol.* 157:4918-4925, 1996.

41. Wooldridge, J.E., Ballas, Z., Krieg, A.M., and Weiner, G.J.: Immunostimulatory Oligodeoxynucleotides Containing CpG Motifs Enhance the Efficacy of Monoclonal Antibody Therapy of Lymphoma. *Blood* 89:2994-2998, 1997.

42. Schwartz, D., Quinn, T.J., Thorne, P.S., Sayeed, S., Yi, A.-K., and Krieg, A.M.: CpG motifs in bacterial DNA cause inflammation in the lower respiratory tract. *J. Clin. Invest.* 100:68-73, 1997.

43. Krieg, A.M., Matson, S., Cheng, K., Fisher, E., Koretzky, G.A., and Koland, J.G.: Identification of an Oligodeoxynucleotide Sequence Motif that Specifically Inhibits Phosphorylation by Protein Tyrosine Kinases. *Antisense Nuc. Acid Drug Dev.* 7:115-123, 1997.

44. Weiner, G.J., H.-M. Liu, J.E. Wooldridge, C.E. Dahle, and A.M. Krieg. Immunostimulatory Oligodeoxynucleotides Containing the CpG Motif are Effective as Immune Adjuvants in Tumor Antigen Immunization. *Proc. Natl. Acad. Sci. USA* 94:10833-10837, 1997.

45. Chace, J.H., Hooker, N.A., Mildenstein, K.L., Krieg, A.M., and Cowdery, J.S.: Bacterial DNA-Induced NK Cell IFN-γ Production is Dependent on Macrophage Secretion of IL-12. *Clin. Immunol. Immunopath.* 84:185-193, 1997.

46. Macfarlane, D.E., Manzel, L., and Krieg, A.M.: Unmethylated CpG-Containing Oligodeoxynucleotides Inhibit Apoptosis in WEHI-231 B-

IV. Other Comments

Lymphocytes Induced by Several Agents: evidence for blockade of apoptosis at a distal signaling step. *Immunology* 91:586-593, 1997.

47. Chu, R.S., Targoni, O.S., Krieg, A.M., Lehmann, P.V., and Harding, C.V.: CpG oligodeoxynucleotides Act as Adjuvants that Switch on Th1 Immunity. *J. Exp. Med.* 186:1623-1631, 1997.

48. Anitescu, M., Chace, J.H., Tuetken, R., Kyung, A.-E., Berg, D.J., Krieg, A.M., and Cowdery, J.S.: IL-10 Functions *In Vitro* and *In Vivo* to Inhibit Bacterial DNA-Induced Secretion of IL-12. *J. Interferon and Cytokine Res.* 17:781-788, 1997.

49. Davis, H.L., Weeratna, R., Waldschmidt, T.J., Tygrett, L., Schorr, J., and Krieg, A.M.: CpG DNA is a Potent Adjuvant in Mice Immunized with Recombinant Hepatitis B Surface Antigen. *J. Immunol.* 160:870-876, 1998.

50. Yi, A-K., and Krieg, A.M.: CpG DNA rescue from anti-IgM induced WEHI-231 B Lymphoma Apoptosis Via Modulation of IκBα and IκBβ and Sustained Activation of Nuclear Factor-κB/c-Rel . *J. Immunol.* 160:1240-1245, 1998.

51. Yi, A.-K., Tuetken, R., Redford, T., Kirsch, J., Waldschmidt, M., and Krieg, A.M: CpG motifs in bacterial DNA activate leukocytes through the pH-dependent generation of reactive oxygen species. *J. Immunol.* 160:4755-4761, 1998.

52. Moldoveanu, Z., Love-Homan, L., Huang, W.Q., and Krieg, A.M.: CpG DNA, A Novel Adjuvant for Systemic and Mucosal Immunization with Influenza Virus. *Vaccine* 16:1216-1224, 1998.

53. Redford, T.W., Yi, A.-K., Ward, C.T., and Krieg, A.M. Cyclosporine A enhances IL-12 production by CpG motifs in bacterial DNA and synthetic oligodeoxynucleotides. *J. Immunol.* 161:3930-3935, 1998.

54. Kline, J.N., Businga, T.R., Waldschmidt, T.J., Weinstock, J.V., and Krieg A.M.: Modulation of Airway Inflammation by CpG Oligodeoxynucleotides in a Murine Model of Asthma. *J. Immunol.* 160:2555-2559, 1998.

55. Weeranta, R., Brazolot Milan, C.L., Krieg, A.M., and Davis, H.L.: Reduction of Antigen Expression from DNA Vaccines by Co-Administered Oligodeoxynucleotides. *Antisense Nucleic Acid Drug Devel.* 8:351-356, 1998.

56. Yi, A.-K., and Krieg A.M.: Rapid induction of mitogen activated protein kinases by immune stimulatory CpG DNA. *J. Immunol.* 161:4493-4497, 1998.

57. Yi, A.E., Chang, M., Peckham, D.W., Krieg, A.M., and Ashman, R.F.: CpG Oligodeoxyribonucleotides Rescue Mature Spleen B Cells from Spontaneous Apoptosis and Promote Cell Cycle Entry. *J. Immunol.* 160:5898-5906, 1998.

IV. Other Comments

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IV. Other Comments

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25. Krieg, A.M.: CpG Oligonucleotides as Immune Adjuvants. Ernst Schering Research Foundation Workshop. (30):105-118, 2000.

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Other:

B. Areas of Research Interest and Current Projects

1. Abnormalities of gene expression and regulation in autoimmune diseases.
2. Mechanisms of action and therapeutic applications of immune stimulatory CpG oligonucleotides.
3. Cytokine regulation of B and T cell development and activation.
4. Mechanisms of immune regulation by CpG DNA.

C. Grants

Federal:

Title: (Include source in parenthesis)	Amount	Period	% Effort	% Salary
Cellular Activation in Prostate Cancer (VA Research Enhancement Award Program [REAP] – D. Lubaroff – PI		01/01/00 – 12/31/04		
Activation of Innate Immunity by CpG DNA for Broad Spectrum Protection Against Pathogens (DARPA, Krieg PI) total $4.4 million	$165,383	05/01/99 – 04/30/01	20%	
Prevention Of Anthrax Infection By CpG Oligodeoxynucleotides (DARPA, Krieg PI)	Annual direct costs: $6,000,000	June 3, 2002 – June4, 2005 (last yr is no-cost ext.)	20%	
Pulmonary Innate Immune Activation for Bioterror Defense (NIAID UO1 AI057264-01 Krieg PI)	Annual direct costs: $2,200,000	9/10/03-3/10/06	30%	
Innate Immune Receptors and Adjuvant Discovery: Discovery And Development Of Novel TLR7, TLR8, And/Or TLR9 Ligands For Bioterror Defense (NIAID Contract No. HHSN266200400044; PI Krieg)	first yr direct costs: $3,545,113 (total $16,902,113)	6/30/04-6/29/09	20%	

E. Invited Lectures

IV. Other Comments

Conference presentations:

1. WHUR, "Lifeline." October 8, 1989 and November 12, 1989.

2. Voice of America, "Frontiers in Science." October 30, 1989.

3. Invited Speaker: Workshop on Retroviruses and Autoimmunity. Basel Institute of Immunology, Basel, Switzerland, October 3-5, 1990.

4. Invited Speaker: "Overview of the Advances in Antisense Therapeutics." DNA Probes: Challenges and Opportunities. San Diego, CA, November 13, 1990.

5. Invited Speaker: "Basic Research, Future Developments in Antisense." Bioeast '91, Antisense Therapeutics Program, Washington, DC, January 6-9, 1991.

6. Invited Speaker: "Oligonucleotides: Cellular Uptake and Use as a Research Tool and Therapeutic Agent." Cambridge Conferences: Gene Therapy and Antisense Therapeutics, San Diego, CA, April 17-19, 1991.

7. Invited Speaker: "A Possible Role for Endogenous Retroviruses in Autoimmune Diseases." September 2, 1991; "Making Sense from Antisense: Immune Regulation by Endogenous Retroviral Proteins." Institute of Clinical Physiology, University of Ulm, Germany, September 3, 1991.

8. Invited Speaker: "Endogenous Retroviruses: Potential Etiologic Agents of Autoimmunity?" Department of Molecular Biology, University of Aarhus, Denmark, August 29, 1991.

9. Invited Speaker: "Retroviruses (Endogenous and Exogenous) in Autoimmunity." 2nd International Symposium on Retrovirus in Multiple Sclerosis and Related Diseases, Copenhagen, Denmark, August 26-28, 1991.

10. Minisymposium Speaker: "Role of Retroviruses in Idiopathic Autoimmune Rheumatic Diseases." Retroviruses and Autoimmunity Minisymposium, American College of Rheumatology Annual Meeting, Boston, November 18, 1991.

11. Plenary Speaker: "Endogenous Retroviruses and Autoimmunity." 12th Annual European Rheumatology Workshop, Arnhem, The Netherlands, March 13, 1992.

12. Keynote Speaker: "Antisense Drug Development." Innovative Drug Development; Companies, Technologies and Opportunities, New York, NY, March 31, 1992.

13. Keynote Speaker: "Antisense Therapeutics." Clinical Advances in Biotechnology Health Care Conference, New York, NY, June 15, 1992.

14. Symposium Speaker: "Basic Research and Potential Clinical Applications in Antisense Therapy." Use of Antisense Constructs in Studies of Hormone Actions Symposium, The Endocrine Society Annual Meeting, San Antonio, TX, June 27, 1992.

IV. Other Comments

15. Invited Speaker: "Endogenous Retroviruses and Murine Lupus." First International Meeting on Endogenous Retroviruses in Multiple Sclerosis and Autoimmune Diseases, Villa D'este, Como, Italy, September 19, 1992.

16. Invited Speaker: "A Role for Endogenous Type C Retroviruses in Murine Immune Regulation." Workshop on Retroviruses as Antigens and Superantigens in Autoimmunity and Tolerance, Basel Institute of Immunology, Basel, Switzerland, September 28, 1992.

17. Invited Speaker: "Efficacy and Uptake of Modified Antisense Oligonucleotides." Banbury Center Conference on Oligonucleotide Manipulation of Gene Expression: Its Therapeutic Potential. Cold Spring Harbor Laboratory, Long Island, NY, October 14, 1992.

18. Invited Speaker: "Therapeutic Potential of Antisense Oligonucleotides." San Diego Conference on Nucleic Acids: Genetic Recognition, San Diego, CA, November 19, 1992.

19. Invited Speaker and Session Chairperson: "Cellular Uptake and Biologic Efficacy of Phosphodiester, Phosphorothioate, and Chimeric Oligodeoxynucleotides." Keystone Symposium on Antisense and Gene Therapy, Keystone, CO, April 13, 1993.

20. Plenary Speaker: "Association of Endogenous Retroviruses with Autoimmunity." 37th Annual Meeting of the Japan Rheumatism Association, Nagoya, Japan, May 23, 1993.

21. Workshop Speaker: "Applications of Antisense Oligonucleotides in Culture." Annual Meeting of the Society for the Study of Reproduction, Fort Collins, CO, August 1, 1993.

22. Seminar Speaker: "Dysregulation of Endogenous Retroviral Transcription in Autoimmune Mice." Rocky Mountain Laboratory, National Institutes of Health, Hamilton, MT, September 27, 1993.

23. Plenary Speaker: "Possible Involvement of Retroviruses in Autoimmune Diseases." Second European Conference on Systemic Lupus Erythematosus, Erlangen, Germany, October 28, 1993.

24. Study Group Speaker: "Status Report: Is There a Virus in Sjögren's Syndrome?" Annual Meeting of the American College of Rheumatology, San Antonio, TX, November 10, 1993.

25. Invited Speaker: "Mechanisms of Oligonucleotide Uptake and Biological Effects." Amgen Antisense Minisymposium, Boulder, CO, March 11, 1994.

26. Invited Speaker: "Environmental Factors and Lupus." University of Iowa Rheumatology Symposium, Iowa City, IA, March 31, 1994.

27. Session Chairperson: "Antisense." 85th annual meeting of the American Association for Cancer Research, San Francisco, CA, April 12, 1994.

IV. Other Comments

28. Invited Speaker: "Antisense Approaches Applications to Lung Disease." NHLBI Workshop, Bethesda, MD, September 23, 1994.

29. Seminar Speaker: "Antisense and Non-Antisense Effects of Oligonucleotides: Prospects for Human Therapy." Alza Corporation, Palo Alto, CA, January 18, 1995.

30. Seminar Speaker: "An Immune Defense Mechanism Activated by Bacterial DNA or Synthetic Oligodeoxynucleotides Containing CpG Motifs." Max Planck Institut, Freiburg, Germany, February 8, 1995.

31. Seminar Speaker: "An Immune Defense Mechanism Activated by Bacterial DNA or Synthetic 'Antisense' or Nonsense Oligodeoxynucleotides Containing CpG Motifs." GSF, Munich, Germany, February 9, 1995.

32. Invited Speaker and Session Chairperson: "Pharmacology." 2nd International Conference on Antisense Nucleic Acids, Garmisch-Parten-Kircher, Germany, February 14, 1995.

33. Keynote Speaker: "Immune Activation by Bacterial DNA." Abbott Laboratories, CAPD Scientist of the Year Awards, March 9, 1995.

34. Invited Speaker: "The Immune Effects and Possible Applications of Bacterial DNA." Diamond Animal Health, Inc., Des Moines, IA, April 26, 1995.

35. Seminar Speaker: "Making Sense from Antisense: Immune Activation by CpG DNA Motif." Hoffman LaRoche, Nutley, NJ, May 4, 1995.

36. Invited Speaker: "Non-Antisense Immune Effects of Oligonucleotides." Cambridge Healthtech Institute Conference on Nucleic Acid Therapeutics, San Diego, CA, June 19, 1995.

37. Invited Speaker: "Immune Activation by Bacterial DNA." Thomas Jefferson University, Philadelphia, PA, June 29, 1995.

38. Seminar Speaker: "Immune Stimulating Effects of DNA Containing CpG Motifs." NEXstar Pharmaceuticals, Inc., August 25, 1995.

39. Staff College Seminar Speaker: "Characteristics of Antisense Oligonucleotides as Therapeutic Agents and Issues on Their Pharmacokinetics and Unintended Mechanisms of Action." Center for Drug Evaluation and Research, FDA, Rockville, MD, September 14, 1995.

40. Seminar Speaker: "Immune Activation by Bacterials DNA and Oligonucleotides Containing CpG Motifs." Center for Biological Evaluation and Research, FDA, Bethesda, MD, September 14, 1995.

41. Seminar Speaker: "Bacterial DNA: An Activator of Innate Immune Defenses?" Microbiology and Immunology Department, Tulane University School of Medicine, September 20, 1995.

IV. Other Comments

42. Session Chair and Speaker: "Immune Effects of Oligonucleotides." Nature Medicine Conference on "The Art of Antisense," New Orleans, September 22, 1995.

43. Invited Speaker: "Immune Effects of Oligonucleotides with CpG Motifs." Isis Pharmaceuticals, Carlsbad, CA, September, 28, 1995.

44. Plenary Speaker: "Immune Activation by Bacterial DNA." Annual Meeting of the Central Society, American Federation for Clinical Research, Chicago, IL, September 30, 1995.

45. Seminar Speaker: "The Possible Role of Bacterial DNA in Innate Immunity and Autoimmunity." Rheumatology Seminar, University of Chicago, Chicago, IL, October 10, 1995.

46. Invited Speaker: "Induction of Cytokine Secretion by CpG Motifs in Bacterial DNA." 2nd Annual Inflammatory Cytokine Antagonists Meeting, Boston, MA, November 13, 1995.

47. Seminar Speaker: "Immune Stimulation by CpG Motif of Oligonucleotides: Mechanism and Therapeutic Potential." Seminar Series Hybridon, Inc., Worcester, MA, November 13, 1995.

48. Seminar Speaker: "Making Sense Out of Antisense: Identification of Immune Stimulatory Nucleotides." Molecular Sciences Seminar, Pfizer, Inc., Groton, CT, November 14, 1995.

49. Seminar Speaker: "Bacterial DNA: Mediater of Innate Immunity and Autoimmunity." University of Chicago, January 15, 1996.

50. Invited Speaker: "CpG DNA: Role in Innate Immunity and Autoimmunity." Second Symposium on Autoimmunity, Baltimore, MD, March 3, 1996.

51. Session Chair and Speaker: "Mechanisms of Immune Recognition of Bacterial DNA." Annual Meeting of the American Society for Microbiology, New Orleans, LA, May 21, 1996.

52. Plenary Speaker: "Using Nature's Tools: Therapeutic Applications of Immune Stimulatory Oligonucleotides." International Congress on Therapeutic Oligonucleotides, Rome, Italy, June 11, 1996.

53. Seminar Speaker: "Activation of Innate Immune Defenses by CpG Motifs in Microbial DNA." University of Zurich, Zurich, Switzerland, July 15, 1996.

54. Oral Presentation: "Bacterial DNA or Oligonucleotides Containing CpG Motifs Protect Mice from Lethal L Monocytogenes Challenge." Molecular Approaches to the Control of Infectious Diseases Meeting, Cold Spring Harbor, NY, September 9-13, 1996.

55. Seminar Speaker: "Activation of Innate Immunity by Bacterial DNA and Oligonucleotides with CpG Motifs, Mechanisms and Therapeutic Applications." NIH Research Day, September 17, 1996.

IV. Other Comments

56. Invited Discussant: CIBA Foundation Symposium on Therapeutic Oligonucleotides, London, England, January 6-10, 1997.

57. Invited Speaker: "Using a 'Danger Signal': Vaccine Applications of Immune Stimulatory Bacterial DNA." IBC 4th Annual Vaccines Conference, Rockville, MD, January 24, 1997.

58. Seminar Speaker: "How the Immune System Detects Bacterial DNA Through CpG Motifs, A Danger Signal." Technical University of Munich, Munich, Germany, February 10, 1997.

59. Symposium Speaker: "CpG Motifs in Bacterial DNA Induce the Rapid Generation of Reactive Oxygen Species in B Cells and Macrophages Which Results in NFκB Activation and Induction of Cytokine Expression." Annual Meeting of the American Assoc. of Imm., San Francisco, CA, February 24, 1997.

60. Seminar Speaker: "Activation of Innate Immunity by CpG Motifs in Bacterial DNA." Case Western Reserve University, Cleveland, OH, March 4, 1997.

61. Symposium Speaker: "Genetic and Environmental Risks for SLE." 1997 Central Region Meeting, American College of Rheumatology, Chicago, IL, April 11, 1997.

62. Invited speaker and session chair: "From Experimental Artifact to Drug: Mechanisms and Applications of CpG DNA." Nature Biotechnology Conference, "Antisense 97," Boston, MA, May 1, 1997.

63. Round table discussant: "Antisense 97," Nature Biotechnology Conference, Boston, MA, May 2, 1997.

64. Invited Speaker: "Unmethylated CpG DNA: An Inducer of Early Response Gene and Cytokine Transcription," FASEB Summer Conference on biological Methylation, Saxtons River, VT, June 17, 1997.

65. Invited Speaker: "B Cell and Macrophage Stimulation by CpG DNA Through a Reactive Oxygen Mediated Pathway," FASEB Summer Conference on Autoimmunity, Saxtons River, VT, June 25, 1997.

66. Invited Speaker: "Immune Effects and CpG Motifs," Gordon Research Conference on Genetic Vaccines, Plymouth, NH, July 21, 1997.

67. Invited Speaker: "CpG DNA, a Potent Pathogenic Factor in Lupus?" Novel Perspectives on Systemic Lupus Erythematosus: From Basic Research to Clinical Applications, National Institutes of Health, Bethesda, MD, November 6, 1997.

68. Invited Speaker: "How the Immune System Sees 'Danger' in Bacterial DNA," Lerner Research Institute, The Cleveland Clinic Foundation, Cleveland, OH, January 21, 1998.

IV. Other Comments

69. Seminar Speaker: "Increasing Vaccine Efficacy: The Mechanisms and Therapeutic Applications of CpG DNA," St. Louis University Vaccine Center, St. Louis, MO, February 13, 1998.

70. Seminar Speaker: "Molecular Mechanisms and Therapeutic Applications of Immune Activation by CpG DNA," Technical University of Munich, Munich, Germany, February 24, 1998.

71. Invited Speaker: "How the Immune System Sees 'Danger' in Bacterial DNA," Cologne Spring Meeting in Molecular Medical Genetics, Cologne, Germany, February 25, 1998.

72. Symposium Speaker: "Mechanisms and Veterinary Applications of Immune Stimulatory CpG DNA," Mini-Symposium on Genetic Vaccines, Groton, CT, February 27, 1998.

73. Invited Speaker: "CpG Motifs in Immune Activating DNA," American Thoracic Society International Conference, Chicago, IL, April 28, 1998.

74. Invited Speaker: "Immune Effects and Mechanisms of Action of CpG Motifs," 3rd National Symposium: Basic Aspects of Vaccines, Washington, DC, April 30, 1998.

75. Participant: "Expert Panel on the Basic Immunology of Vaccines," National Institutes of Health, Division of Allergy, Immunology and Transplantation, NIAID, Bethesda, MD, June 9, 1998.

76. Invited Speaker: "Activation of Innate and Acquired Immune Responses by CpG Motifs in Bacterial DNA," Stanford University School of Medicine Immunology Seminar Series, Stanford, CA, October 20, 1998.

77. Invited Speaker: "Antisense: Discovery and Milestone Achievements," Third NIH Symposium on Therapeutic Oligonucleotides, Bethesda, MD, December 4, 1998.

78. Invited Speaker: "Mechanisms and Applications of CpG DNA," Society of Toxicology, 38th Annual Meeting, New Orleans, LA, March 17, 1999.

79. Invited Speaker: "Role of CpG DNA in Lung Cancer Treatment," Thoracic Malignancies: Prevention, Early Diagnosis and Treatment, University of Iowa, Iowa City, IA, March 12, 1999.

80. Invited Speaker: "CpG Immunostimulatory Sequences for Therapeutic Vaccines," Second Annual Conference on Vaccine Research, National Institutes of Health, NFID, Bethesda, MD, March 29, 1999.

81. Invited Speaker: "Mechanisms and Applications of Immunostimulatory CpG DNA," Onkologisches Forum Nordwest, University of Frankfurt, Frankfort, Germany, May 26, 1999.

82. Invited Speaker: "CpG-Oligonucleotides as Immune Adjuvants," Ernst Schering Research Foundation Workshop 30, "Therapeutic Vaccination Strategies," Berlin, Germany, May 28, 1999.

IV. Other Comments

83. Invited Speaker: "Mechanisms and Effects of Immunostimulatory and Immune Neutralizing CpG DNA and Their Implications for Designs of Gene Therapy Vectors," American Society of Gene Therapy, 2nd Annual Meeting, University of Pennsylvania, Philadelphia, PA, June 13, 1999.

84. Invited Speaker: "The Role of Immune Stimulatory CpG DNA in Enhancing Vaccine Efficacy," 26th International Meeting, Controlled Release Society, Inc., Boston, MA, June 22, 1999.

85. Invited Speaker "State-of-the-Art Lecture": "From Bugs to Drugs: Therapeutic Immunomodulation with CpG Sequences from Bacterial DNA," Annual Meeting of the Central Society for Clinical Research, Chicago, IL, September 17, 1999.

86. Co-Organizer: "Immunobiology of Bacterial CpG-DNA," 1st International Workshop on Bacterial CpG DNA, Schloss Elmau/Upper Bavaria, September 26-29, 1999.

87. Invited Speaker: "CpG-DNA Effects Towards B Cells," 1st International Workshop on Bacterial CpG DNA, Schloss Elmau/Upper Bavaria, September 27, 1999.

88. Invited Speaker: "Molecular Mechanisms of B Cell Activation," 1st International Workshop, Schloss Elmau/Upper Bavaria, September 27, 1999.

89. Invited Speaker: "Immune Effects and Therapeutic Applications of CpG Motifs in Bacterial DNA," International Symposium on Respiratory Immunology, Lovelace Respiratory Research Institute, Santa Fe, NM, October 13, 1999.

90. Invited Speaker: "Biology and Use of Immunostimulatory CpG DNA," 5th International Symposium, Biological Therapy of Cancer: From Basic Research to Clinical Application, Munich, Germany, October 28, 1999.

91. Invited Speaker: "Immune Stimulatory Effects of CpG Motifs in Bacterial DNA and Applications as a Vaccine Adjuvant," University of Alabama, Birmingham, AL, November 2, 1999.

92. Invited Speaker: "Molecular Mechanisms and Therapeutic Applications of Immune Stimulatory CpG Motifs in Bacterial DNA," Florida Atlantic University, Center for Molecular Biology and Biotechnology, Ft. Lauderdale, FL, November 18, 1999.

93. Invited Speaker: "CpG Oligonucleotide Adjuvants," American Society of Tropical Medicine and Hygiene, 48th Annual Meeting, Washington, DC, November 28 to December 2, 1999.

94. Invited Speaker: "From Bugs to Drugs; Mechanisms and applications of Immune Stimulatory Bacterial CpG DNA," Armed Forces Research Institute of the Medical Sciences, Bangkok, Thailand, January 14, 2000.

IV. Other Comments

95. Immunology Seminar Speaker: "Immune Stimulatory Bacterial DNA," Wistar Institute, University of Pennsylvania, Philadelphia, PA, March 1, 2000.

96. Invited Seminar Speaker: "Innate Immunity," Fellows in Training Symposium, AAAAI 56th Annual Meeting, San Diego, CA, March 3, 2000.

97. The Richard S. Farr Memorial Lecturer Plenary Session: "The Future of Vaccines for Prevention and Treatment," AAAAI 56th Annual Meeting, San Diego, CA, March 4, 2000.

98. Invited Speaker, "CpG Immune Stimulatory Sequences for Therapeutic Cancer Vaccines and Nonspecific Immunotherapy," 2nd Annual Colloquium on Cancer Vaccines and Immunotherapy, Walker's Cay, Bahamas, March 8-11, 2000.

99. Invited Speaker, "Causing a Commotion in the Blood; Cancer Immunotherapy with Bacteria," VA Central Office, Medical Research Service, Washington, DC, April 4, 2000.

100. Invited Speaker, "Causing a Commotion in the Blood; Cancer Immunotherapy with Bacteria and Bacterial CpG DNA," University of Connecticut School of Medicine, Farmington, CT, April 6, 2000.

101. Plenary Speaker: "Cancer Immunotherapy with Bacterial DNA," Germany Association of Dermatology and Allergology Annual Meeting, Essen, Germany, April 15, 2000.

102. Seminar Speaker: "Mechanisms and Applications of Immune Stimulatory Bacterial DNA," Department of Microbiology, University of Texas, Galveston, May 17, 2000.

103. Symposium Speaker: "Immune Activation by DNA," American Society of Gene Therapy Satellite Meeting, Beaver Creek, Colorado, June 5, 2000.

104. Seminar Speaker: "Immunotherapy with Immune Stimulating DNA," Division of Oncology, University of Minnesota, August 21, 2000.

105. Invited Speaker: "CpG Oligonucleotides," New Trends in Allergy V, Davos, Switzerland, September 15-17, 2000.

106. Invited Speaker: "Initiation of Costimulatory Signals by CpG Motifs in Bacterial DNA," Joint Annual Meeting of Immunology of the German and Dutch Societies, Duesseldorf, Germany, November 29, 2000.

107. Plenary Speaker: "Immunotherapy with CpG motifs from bacterial DNA," Cancer Vaccines 2000 Cancer Research Institute International Symposia Series, New York, NY, October 2, 2000

108. Invited Speaker: "Seeing the CpGs in DNA: Activation of Innate and Acquired Immunity by Pathogen DNA," New York Blood Center, New York, NY, April 12, 2001.

IV. Other Comments

109. Invited Speaker: Biology and clinical perspectives of CpG oligonucleotides lecture. "Innate Immunity: Receptors and Effectors," Didactic Annual Meeting of the Netherlands Society of Immunology, Amsterdam, Netherlands, April 26-27, 2001.

110. Invited Speaker: Strategies for Targeting the Immune System. "Activation of innate and adaptive immunity with CpG DNA," The VIIth International Antibody Conference on Targeted Cellular Cytotoxicity, Southampton, SO, United Kingdom, July 31-August 2, 2001.

111. Chairperson: "Rethinking the Pathogenesis of Asthma," Keystone Symposium, Santa Fe, New Mexico, February 8-13, 2002.

112. Invited Speaker: Gene-Based Vaccines: Mechanisms, Delivery Systems and Efficacy. "Applications of CpG DNA in Oncology," Keystone Symposia, Breckenridge, CO, April 10-15, 2002.

113. Invited Speaker: Immune Mechanisms and Disease. "Activation of Innate and Acquired Immunity with CpG Motifs from Bacterial DNA," The Henry Kunkel Society, St. George's, Grenada, West Indies, April 14-17, 2002.

114. Session Chair: "Immune Targets: Innate Immune Molecules," National Institute of Allergy and Infectious Diseases (NIAID), Bethesda, MD, June 17, 2002.

115. Invited Speaker and Session Chair: "Defending against Bioterror by Activation of Innate Immunity with CpG DNA" Cambridge Healthtech Institute, Newton Upper Falls, MA, November 5, 2002.

116. Invited Speaker: "From CFA to CpG: Vaccine adjuvants go from art to science," 28th New England Immunology Conference, Marine Biological Laboratory, Woods Hole, MA, November 16-17, 2002.

117. Invited Speaker: "Alternative Approaches: Activated Protein C," American Society for Microbiology: Future Directions for Biodefense Research: Development of Countermeasures, Waterfront Marriott, Baltimore, MD, March 9-12, 2003.

118. Invited Speaker. "CpG Immunology: from the lab to the clinic," International Symposium, Molecular Diagnostics & Skin Gene Therapy, Dept. of Dermatology, Heinrich-Heine-University, Düsseldorf, GERMANY, March 27-29, 2003.

119. Invited Speaker. "Case study: reducing vaccine requirements by *in vivo* activation of dendritic cells with CpG DNA," World Vaccine Congress 2003, The Hilton Montréal Bonaventure, Montréal, CANADA, April 7-9, 2003.

120. Invited Speaker. "CpG DNA: trigger of sepsis, or mediator of protection, or both?" Karolinska Institutet Nobel Symposium No 124, Septicemia and Shock: Pathogenesis and Novel Therapeutic Strategies, Karolinska Institutet, Stockholm, SWEDEN, May 15-17, 2003.

IV. Other Comments

121. Invited Speaker. "The role of the TLR9 pathway in plasmacytoid dendritic cell activation and induction of innate immunity," 4th International Expert Meeting on Clinical Dendritic Cell Immunotherapy, Royal Tropical Institute, Amsterdam, NETHERLANDS, June 13-16, 2003.

122. Invited Speaker. "Enhance Therapeutic Vaccination with CpG Oligos," CIB's 2nd Annual Commercializing Therapeutic Cancer Vaccines, Hyatt Regency Washington on Capitol Hill, Washington, DC, July 24-25, 2003.

123. Invited Speaker. "Application of CpG Oligonucleotides in Cancer Therapy," Biological Therapy of Cancer 7th International Congress, Munich, GERMANY, September 10-13, 2003.

124. Invited Speaker. "Clinical Applications of Stimulating TLR9 with CpG Oligos," First Annual Symposium Frontiers in Molecular Medicine, The Emerging Role of Toll-like Receptors in Biology and Medicine, Boston University School of Medicine and Boston Medical Center, Boston, MA, October 3, 2003.

125. Invited Speaker. "Activation of Innate and Adaptive Immunity through TLR9 for Tumor Immunotherapy," The Lerner Research Institute, Cleveland Clinic Foundation, Taussig Cancer Center, Department of Cancer Biology, Cleveland, Ohio, October 14, 2003.

126. Keynote Presentation. "Enhancing vaccines with adjuvants that activate dendritic cells and B cells *in vivo*," Agricultural Research Service Immunology Research Workshop, Bethesda Marriott, Bethesda, MD, December 1-4, 2003.

127. Invited Speaker. "Recognition of unmethylated CpG motifs in bacterial DNA by TLR9 and activation of immunity," University of North Carolina, Chapel Hill, NC, December 17, 2003.

128. Grand Rounds Speaker. "CpG Oligodeoxynucleotides in Cancer Therapy – Biology," Division of Radiation Oncology Grand Rounds, The University of Texas, MD Anderson Cancer Center, Houston, TX, January 7, 2004.

129. Plenary Speaker: "CpGs," Chemical & Biological Terrorism Defense, Rancho Santa Barbara Marriott, Buellton, CA, January 18-23, 2004.

130. Invited Speaker: "Immune therapeutic applications of stimulating TLR9 with B-Class and C-Class CpG oligos," 2nd International Conference, Strategies for Immune Therapy, Congress Center, Würzburg, GERMANY, February 29-March 3, 2004.

131. Invited Speaker: "Toll-like Receptor 9: An On/Off Switch for Immunotherapy?" Program in Immunology, University of Alabama School of Medicine, Birmingham, AL, April 1, 2004.

132. Guest Lecture: "Targeting TLR9 for tumor immunotherapy," Research Seminars in Clinical Oncology, UniversitätsSpital Zürich, Grosser Hörsaal OST, Gloriastrasse 29, 8091 Zürich, April 5, 2004.

IV. Other Comments

133. Invited Speaker: "Enhancing Cancer Vaccines By *In Vivo* Activation of TLR9 with CpG Oligos," International Cancer Vaccine Meeting, Rome, Italy, April 19, 2004.

134. Invited Speaker:"Stimulating TLR9 with Promune to Drive Innate and Adaptive Anti-Tumor Responses," Southwestern Oncology Group Spring Meeting, Huntington Beach, CA, April 30, 2004.

135. Invited Speaker "TLR Agonists," TLR Meeting, Tamorina, ITALY, May 8-10, 2004.

136. Invited Speaker "Regulation of Th2 and autoimmune responses by stimulation and suppression of the TLR9 pathway," Frontiers in Allergy and Autoimmunity International Symposium, Johannes Gutenberg-University Mainz, Mainz, GERMANY, May 21-22, 2004.

137. Invited Speaker "Mechanisms and Therapeutic Applications of Immune Stimulatory Bacterial CpG DNA," The NIH Director's Wednesday Afternoon Lectures, Masur Auditorium, Building 10, Washington, DC, May 28, 2004.

138. Invited Speaker "Activation of TLR9 by CpG Motifs: Preclinical and Clinical Studies," The American Society of Gene Therapy's 7th Annual Meeting, Minneapolis, MN, June 2-6, 2004.

139. Invited Speaker "Regulation of Inflammatory Responses through TLR9," IBC's Second Annual Inflammatory Diseases Targeting and Control of Innate Immunity Pre-Conference Symposium, Hilton Logan Airport, Boston, MA, June 23-25, 2004.

140. Invited Speaker "Activation of Innate and Adaptive Immunity by CpG Motifs: Discovery, Mechanisms and Clinical Applications," Technology Fair for Inventors in the Biotechnology, Organic Chemistry and Pharmaceutical ARTS, Patent and Trademark Office (US Patent Office), Remsen Building, Conference Room, Alexandria, VA, July 13, 2004.

141. Plenary Speaker: "Stimulating Immunity Through TLR9 with CpG," 12th International Congress of Immunology and 4th Annual Conference of FOCIS, Montréal, CANADA, July 18-23, 2004.

142. Plenary Speaker: "Activation of Innate or Adaptive Anti-microbial Immunity Through *In Vivo* Stimulation of Toll-like Receptor 9," 55th Annual Meeting, Society of General Microbiology, Dublin, IRELAND, September 6, 2004.

143. Plenary Speaker: "Immune Stimulatory ORN and CpG ODN Agonists for Toll-like Receptors," XVIth International Round Table on Nucleosides, Nucleotides & Nucleic Acids, Minneapolis, Minnesota, September 12-16, 2004.

IV. Other Comments

144. Invited Speaker: "Regulation of innate and adaptive immunity and autoimmunity by toll-like receptor 9 (TLR9)," 4th Global Arthritis Research Network (GARN) Symposium, Hôtel Omni Mont-Royal, Montreal, CANADA, September 20-22, 2004.

145. Invited Speaker: "Enhancing vaccination by *in vivo* plasmacytoid dendritic cell activation through TLR9 with CpG oligos," Vaccines 3: Frontiers in vaccine development, Paris, FRANCE, October 7-8, 2004.

146. Invited Speaker: "Mechanisms of therapeutic applications of oligodeoxynucleotide ligands for Toll-like receptor 9," Vortrag im Rahmen des ZAFES CpG-Clusters, Goethe University, Frankfurt, GERMANY, October 29, 2004.

147. Seminar Speaker: "Immunotherapy with Bacterial DNA: From Lab Accident to Drug," Medical Alumni Auditorium, University of Iowa, Iowa City, IA, December 9, 2004.

148. Session Chair and Invited Speaker: "Activating Innate and Adaptive Immunity by in vivo Activation of TLR9 with CpG Oligos', Basic Aspects of Tumor Immunology II, "Toll-Like Receptors/Death, Danger and Dendritic Cells," Keystone Symposia, Keystone Resort, Keystone, CO, March 21, 2005.

149. Invited Speaker and Session Chair: "Regressions Induced in Cutaneous T Cell Lymphoma and Metastatic Melanoma by *in vivo* DC Activation through TLR9," International Symposium on the Biology and Immunology of Cutaneous Lymphoma, Department of Dermatology, Venerology and Allergology, Charité, Universitätsmedizin, Berlin, GERMANY, February 3-5, 2005.

150. Invited Speaker: "New Directions in the Study of Antimicrobial Therapeutics: Immunomodulation," The National Academies, Advisers to the Nation on Science, Engineering, and Medicine, Keck Center of the National Academies, Washington, DC, April 28-29, 2005.

151. Invited Speaker: "Therapy to Link Innate and Adaptive Immunity," American Academy of Allergy, Asthma & Immunology, 61st Annual Meeting, San Antonio, TX, March 18-22, 2005.

152. Invited Speaker: "Enhancing Tumor Vaccination Through *In Vivo* Plasmacytoid Dendritic Cell Activation Via TLR9," Federation of Clinical Immunology Societies 5th Annual Meeting, Westin Copley Place, Boston, MA, May 12-16, 2005.

153. Oral Presentation: "Use of CpG Oligonucleotides to Treat Viral (Hep C and HIV) and Parasitic Diseases," American Society for Microbiology 105th General Meeting, Georgia World Congress Center, Atlanta, GA, June 7, 2005.

154. Plenary Speaker: "G/U-Rich RNAs, CpGs, TLRs, and Anti-Viral Defense," Keystone Symposia, Innate Immunity to Pathogens, Sheraton Steamboat Resort, Steamboat Springs, CO, January 8-13, 2005.

IV. Other Comments

155. Plenary Speaker: "Improved Chemotherapy Response Rate in Metastatic Non-Small Cell Lung Cancer by in Vivo Plasmacytoid Dendritic Cell Activation with CPG 7909, A TLR9 Agonist," Keystone Symposia, Dentritic Cells at the Center of Innate and Adaptive Immunity: Eradication of Pathogens and Cancer and Control of Immunopathology, Fairmont Hotel Vancouver, Vancouver, British Columbia, CANADA, February 1-7, 2005.

156. Invited Speaker: "Therapeutic Potential of CpG DNA," From Innate Immunity to Vaccines, Hilton San Diego Mission Valley, San Diego, CA, June 14-15, 2005.

157. Invited Speaker: "Activating Innate Immunity Through TLR9," Biotechnology Industry Organization (BIO) 2005 Annual International Convention, Philadelphia, PA, June 19-22, 2005.

158. Invited Speaker: "Biodefense Applications of Toll-like Receptor 9 Agonists, CpG Oligos," Innate Immunity in the 21st Century, Advanced Systems and Concepts Office Defense Threat Reduction Agency, Lansdowne Resort, VA, September 27-29, 2005.

159. Session Chair and Invited Speaker: "Advances in the development of TLR therapeutics," Aegean Conferences, Crossroads between Innate and Adaptive Immunity, Rhodes, GREECE, October 9-14, 2005.

160. Invited Speaker: "CpG Oligos to Protect Against Class A Pathogens," 2nd Annual Baylor Symposium on Human Immunology and Biodefense, Dallas, TX, October 30-31, 2005.

161. Symposium Invited Speaker: "Immune Stimulatory Therapeutics," Antisense and Oligonucleotide Therapeutics Symposium, Center for Drug Evaluation and Research, Office of Training and Communications/Divisiion of Training and Development, Committee for Advanced Scientific Education, Rockville, MD, November 1, 2005.

162. Invited Speaker: "Development of a Toll-like Receptor 9 Agonist, CPG 10101, For HCV Therapy," Direct Antivirals & Immune Approaches, Strategic Research Institute 2nd Annual Viral Hepatitis in Drug Discovery & Development, Hilton Boston Back Bay, Boston, MA, February 27-28, 2006.

163. Invited Speaker: "Adjuvants," TOLL2006 (UMass Medical School – Worcester, MA) Recent Advances in Pattern Recognition, Hotel Pestana Bahia, Salvador, BRAZIL, March 4-7, 2006.

164. Immunology Seminar Talk: "Activation of Innate and Adaptive Immunity by Stimulating TLR9 with CpG Oligos: from Laboratory Artifact to Drug," Tufts University, Boston, MA, March 9, 2006.

165. Invited Speaker: "Anti-tumor Applications of *In Vivo* DC Activation Through TLR9," Innate Immunity World Congress, Marriott San Diego, Mission Valley, San Diego, CA, March 20-22, 2006.

IV. Other Comments

166. Invited Speaker: "Update on the Clinical Development of CpG Oligonucleotides," 8th International Symposium Biological Therapy of Cancer from Disease to Targeted Therapy, Dresden, GERMANY, June 21-24, 2006.

167. Invited Speaker: "Activating Toll-Like Receptor 9 for the Treatment of NSCLC," 2nd International Congress Molecular Staging of Cancer, Heidelberg, GERMANY, June 22-26, 2006.

168. Invited Speaker: "Immunotherapy in Lung Cancer," Annual Asia Pacific Conference: Perspectives in Lung Cancer, Pudong, Shanghai, August 4-5, 2006.

169. Invited Speaker: "Immunotherapy Through Toll-Like Receptor 9 (TLR9) in Lung Cancer" 11th Asian Oceanian Congress of Radiology, AOCR 2006 Hong Kong, Hong Kong Convention & Exhibition Centre, August 6-9, 2006.

170. Chairperson: "Chairpersons Remarks," Systems Integration in Biodefense, Washington, DC, August 21-22, 2006.

171. Invited Speaker: "Innate Immune Activation Through TLR9 for Biodefense" Systems Integration in Biodefense, Washington, DC, August 21-22, 2006.

172. Keynote Speaker: "Targeting Toll-Like Receptor 9 for Cancer Therapy," Targeted Immunotherapeutics & Vaccine Summit, Cambridge, MA, August 21-23, 2006.

173. Invited Speaker: "Toll-Like Receptors – Overview and Potential as Anticancer Agents" 5th International Congress on Targeted Therapies in Cancer, The Roosevelt Hotel, New York, NY, August 25-27, 2006.

174. Session Chairperson: "Functional outcomes of B cell signaling and manipulating the B cell response," Rediscovering B cells: Protective and Pathogenic Roles in Infectious and Autoimmune Diseases, Trudeau Institute, New York, October 6-7, 2006.

175. Moderator: "Novel Therapeutic Targets Based on Insights into Disease Pathogenesis," Forum for Discovery: 6th Annual Lupus Research Institute Scientific Conference, Yale Club, New York, October 20, 2006.

176. Invited Speaker and Session Chairperson: "Progress in Gene Targeting Oligonucleotide Therapeutic Development," Second Annual Meeting of the Oligonucleotide Therapeutics Society, The Rockefeller University, New York, October 19-21, 2006.

177. Invited Speaker: "The TLR9 Agonist PF-3512676 (Formerly CPG 7909) Induces T Cell-Mediated Tumor Regression Synergistically with Paclitaxel or Treg Depletion in a Metastatic Murine Cancer Model," 21st Annual Meeting of the International Society for Biological Therapy of Cancer, Los Angeles, CA, October 26-29, 2006.

IV. Other Comments

178. Invited Speaker: "Toll-Receptor Agonists in Lung Cancer," The Third Annual Symposium on The Future of Lung Cancer, Washington, D.C., December 1-2, 2006.

179. Invited Speaker: "Anti-infective and Anti-allergic Applications of Toll-like Receptor 9 Agonists," Transatlantic Airway Conference, Lucerne, Switzerland, January 17-19, 2007.

180. Invited Speaker: "Development of CPG Oligonucleotides," 10th Annual Meeting of the Regional Cancer Center Consortium for the Biological Therapy of Cancer, February 8-9, 2007.

181. Invited Speaker: "Targeting Toll Like Receptor 9 for Human Therapy," Death, Danger & Immunity, Institut Pasteur, Paris, France, March 8-9, 2007.

182. Invited Speaker: "Targeted Activation of Toll-like Receptor 9 (TLR9) for Cancer Therapy," 8th Symposium Cancer Immunosurveillance and Immunotherapy, Zurich, March 14-16, 2007.

183. Invited Speaker: "Approaches to Blocking TLRs for the Treatment of Lupus," International Workshop: Toll-like Receptors and Beyond, Kloster Seeon, Bavaria/Germany, March 18-21, 2007.

184. Chairperson: "Therapeutic Strategies: Stimulation – Suppression of Innate Immune Events," Society of Innate Immunity 1st International Meeting, Patalya, Turkey, May 16, 2007.

185. Chairperson/Invited Speaker: "Clinical Development of CPG," 3rd Annual Meeting of the Oligonucleotide Therapeutic Society, Berlin, Germany, October 4-6, 2007.

186. Invited Speaker: "Update on the Preclinical and Clinical Development of Immune Stimulatory Oligoribonucleotides and Oligodeoxynucleotides," Euro TIDES, Hotel Palace Berlin, Germany, December 4-5, 2007.

187. Invited Speaker: "Development of TLR Agonists for the Treatment of Cutaneous Lymphoma," International Symposium on the Biology and Immunology of Cutaneous Lymphoma, Berlin, Germany, January 10-12, 2008.

188. Invited Speaker: "Overview of Innate Immunity," American Academy of Allergy Asthma & Immunology Annual Meeting, Philadelphia, PA, March 14-18, 2008.

189. Invited Speaker: "Clinical Development of TLR Agonists for Cancer Therapy," National Cancer Institute (NCI) Symposium: Toll-Like Receptor Function in the Cancer Microenvironment, American Association of Immunologists 95th Annual Meeting, San Diego, CA, April 5-9, 2008.

190. Invited Speaker: "Mechanisms of Immune Stimulation by RNA," TIDES 2008, Las Vegas, NV, May 18-21, 2008.

IV. Other Comments

191. Invited Speaker: ""The Other Side of Antisense and siRNA – Immune Stimulation via Toll-like and RIG-I-like Receptors," RNAi Discussion Group on Therapeutic Opportunities of siRNAs and Antagomirs, The New York Academy of Sciences, New York, NY, June 10, 2008.

192. Chairperson/Invited Speaker: "Clinical Opportunities for Immunostimulatory Oligonucleotides," Drug Information Association: 2nd Annual Oligonucleotides-based Therapeutics Conference, Falls Church, VA, September 22-24, 2008.

193. Invited Speaker: "Non-Hybridization Dependent Oligonucleotides," Drug Information Association: 2nd Annual Oligonucleotides-based Therapeutics Conference, Falls Church, VA, September 22-24, 2008.

194. Invited Speaker: "Oligonucleotide drugs as intentional and unintentional immune activators," Toll 2008 Recent Advances in Pattern Recognition, Lisbon, Portugal, September 24-27, 2008.

195. Organizing Committee/Session Chair: "Immunostimulation," The New York Academy of Sciences: Fourth Annual Meeting of the Oligonucleotide Therapeutics Society, Boston, MA, October 15-18, 2008.

196. Session Co-Chair: "Novel Therapeutics and Clinical Trial Development to Treat Cancer," International Society for Biological Rx of Cancer Annual Meeting: Workshop on Cancer and Inflammation, Promise for Biological Therapy, San Diego, CA, October 30, 2008.

197. Invited Speaker: "TLRs – II," Keynote Symposium, *Pattern Recognition Molecules and Immune Sensors of Pathogens*, Banff, Alberta, Canada, March 29 – April 3 2009.

198. Keynote Speaker: "Human Genetics and Oligonucleotides: Essential Partners in Pharma's Future," TIDES Oligonucleotide and Peptide Technology and Product Development, Las Vegas, NV, May 17-20, 2009.

199. Keynote Presenter Question/Answer Panel: "Ask the Experts: Your Opportunity to Ask Specific Questions to the Keynote Presenters," TIDES Oligonucleotide and Peptide Technology and Product Development, Las Vegas, NV, May 17-20, 2009.

200. Session Co-Chair: "Antisense (RNase H-dependent)," Joint Symposium of 5th Annual Meeting of Oligonucleotide Therapeutics Society and the 19th Antisense Symposium, Fukuoka, Japan, November 3 – 6, 2009.

F. Pending Decisions (grant proposals, book contracts)

1990-	Associate Editor, *Lupus News*
1994-	Editorial Board, *Journal of Biomedical Science*
1994-98	Chairperson of Editorial Board, *Lupus News*
1996-99	*Arthritis and Rheumatism,* Advisory Editor
2000-	Editorial Board, *Current Opinion in Immunology*

IV. Other Comments

Review panels:

1991-	Ad Hoc Grant Reviewer, The Arthritis Society of Canada
1992	Ad Hoc Grant Reviewer, The Scleroderma Foundation
1992-98	Ad Hoc Grant Reviewer, The Veterans Administration
1994	Ad Hoc Grant Reviewer, NIH
1995	Ad Hoc Grant Reviewer, The National Science Foundation
1996	NIH-NIDDK Site Visit, New York City to review PPG from Mt. Sinai School of Medicine
1996-98	Molecular Immunology Study Section, The Arthritis Foundation
1998-2001	Immunology Study Section, The Veterans Administration
2001-current	Ad Hoc Grant Reviewer, NIAID (biodefense grants and contracts, Bioshield reviewer), NCI (FLAIR reviewer)
2006	Ad Hoc Abstract Reviewer, The American Society of Gene Therapy

Departmental, collegiate, or university committees:

1993	Executive Committee, Immunology Graduate Program
1994	Cancer Center Seed Grant Review Committee, University of Iowa
1995-96	Promotions Committee, University of Iowa
1995-98	Comprehensive Examination Committee, Immunology Graduate Program
1997	Research Committee, University of Iowa
2008	National Meeting of the American College of Rheumatology

V. SERVICE

A. Clinical assignments (last 5 years)

Inpatient:

None.

Outpatient

1 half-day clinic per month
until 2000

B. Offices Held in Professional Organizations

Editorships:

Year	Activity

IV. Other Comments

1990- Co-editor, *Antisense and Nucleic Acid Drug Development (since 2004 renamed Oligonucleotides)*

2003 Founding Vice President, Oligonucleotide Therapeutic Society

Committees:

1. Member of the National Institute of Allergy and Infectious Disease (NIAID) Blue Ribbon Panel on Influenza Research, Bolger Center, Potomac, MD, September 11, 2006.

2. Co-founder and Vice President, Oligonucleotide Therapeutics Society, 2002.

Departmental, collegiate, or university service positions:

1996	Department of Internal Medicine Research Day Chair
1995	Department of Internal Medicine Research Day Co-Chair

Relevant community involvement

1990	Education and Information Committee, Lupus Foundation of America
1991	Medical Board of Directors, Iowa Chapter, Lupus Foundation of America
1998	Medical Board of Directors, Kidneeds

A. Issued U.S. Patents:

1. "Immunomodulatory Oligonucleotides." #6,194,388, Arthur Krieg, M.D., Joel Kline, M.D, Dennis Klinman, M.D. and Alfred Steinberg, M.D., issued 02/27/01

2. "Immunostimulatory Nucleic Acid Molecules." #6,207,646, Arthur Krieg, M.D., Joel Kline, M.D, Dennis Klinman, M.D. and Alfred Steinberg, M.D., issued 04/05/01

3. "Use of Nucleic Acids Containing Unmethylated CpG Dinucleotides in the Treatment of LPS-Associated Disorders." #6,214,806, Arthur M. Krieg, M.D., issued 04/10/01.

4. "Methods and Products for Stimulating the Immune System Using Immunotherapeutic Oligonucleotides and Cytokines." #6,218,371, Arthur M. Krieg, M.D. and George Weiner, M.D., issued 04/17/01.

5. "Immunostimulatory Nucleic Acid Molecules." #6,239,116, Arthur Krieg, M.D., Dennis Klinman, M.D. and Alfred Steinberg, M.D., issued 05/29/01.

6. "Methods for Regulating Hematopoiesis Using CpG-Oligonucleotides." #SA2000/7071, Hermann Wagner and Grayson Lipford, issued 08/29/01.

IV. Other Comments

7. "Use of Nucleic Acids Containing Unmethylated CpG Dinucleotide in the Treatment of LPS-Associated Disorders." #AU66674/98, David A. Schwartz and Arthur M. Krieg, M.D., issued 01/03/02.

8. "Vectors and Methods for Immunizatiion or Therapeutic Protocols." #6,339,068, Arthur Krieg, M.D., Heather L. Davis, Tong Wu, and Joachim Schorr, issued 01/15/02.

9. "Use of Nucleic Acids Containing Unmethylated CpG Dinucleotide as an Adjuvant". #6,406,705, Heather L. Davis, Joachim Schorr, and Arthur M. Krieg, M.D., issued 06/18/02.

10. "Method of treating cancer using immunostimulatory oligonucleotides". #6,653,292, Arthur M. Krieg, M.D. and George Weiner, issued 11/25/03.

11. "Immunostimulatory Nucleic Acid Molecules". #7,223,741, Arthur M. Krieg, M.D.,, issued 05/29/07.

B. International PCT Application:

1. "Immunomodulatory Oligonucleotides." PCT/US95/01570, Arthur M. Krieg, M.D., filed 2/7/95.

2. "Immunomodulatory Oligonucleotides". PCT/US95/01570, Arthur M. Krieg, M.D., et al, filed 02/07/95.

3. "Immunostimulatory Nucleic Acid Molecules". PCT/US97/19791, Arthur M. Krieg, M.D., et al., filed 10/30/97.

4. "Use of Nucleic Acids Containing Unmethylated CpG Dinucleotide as an Adjuvant". PCT/US98/04703, Arthur M. Krieg, et al, filed 03/10/98.